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	Expires 30 June 2001 Planning REALLOCATION OF FLOOD CONTROL STORAGE TO MUNICIPAL AND INDUSTRIAL WATER SUPPLY-COMPENSATION CONSIDERATIONS	
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DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, D.C. 20314-1000

CECW-P

Circular
No. EC 1105-2-216

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EXPIRES 30 June 2001
Planning
REALLOCATION OF FLOOD CONTROL STORAGE
TO MUNICIPAL AND INDUSTRIAL WATER SUPPLY –
COMPENSATION CONSIDERATIONS

1. Purpose. This circular establishes policy and provides supplemental guidance on analyzing and implementing compensation requirements to existing water supply and/or hydropower users in the event flood control storage is reallocated to municipal and industrial water supply. Procedures and requirements are provided for the analysis and implementation of Dependable Yield Mitigation Storage (DYMS) to compensate water supply users and, where appropriate, to compensate hydropower users through operational changes. Basic guidance on reallocation procedures is in Chapter 4, Section VII, of ER 1105-2-100.

2. Applicability. This circular applies to all HQUSACE elements, major subordinate commands and district commands having Civil Works responsibilities.

3. Distribution Statement. Approved for public release, distribution is unlimited.

4. References. The following U.S. Army Corps of Engineers Publications.

a. ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies.

b. ER 1110-1-8158, Corps-Wide Centers of Expertise Program.

c. ER 1110-2-240, Water Control Management.

d. EM 1110-2-1420, Engineering and Design - Hydrologic Engineering Requirements for Reservoirs.

e. EM 1110-2-1701, Engineering and Design - Hydropower.

f. EM 1110-2-3600, Management of Water Control Systems.

g. IWR Report 96-PS-4, Revised December 1998. Water Supply Handbook.

5. Reallocation - General Information.

a. Authority. Reallocation is the reassignment of the use of existing storage space in a reservoir project to a higher and better use. Authority for the Corps to reallocate existing storage space to municipal and industrial (M&I) water supply is contained in Public Law (P.L.) 85-500, Title III, Water Supply Act of 1958, as amended (72 Stat. 319). Section 301(b), of this Act states ". . . it is hereby provided that storage may be included in any reservoir project surveyed, planned, constructed or to be surveyed, planned, and/or constructed . . . to impound water for present or anticipated future demand or need for municipal and industrial water supply." Section 301(d) of the Act states "[M]odifications of a reservoir project heretofore authorized, surveyed, planned, or constructed to include storage as provided in subsection (b), which would seriously affect the purposes for which the project was authorized, surveyed, planned, or constructed, or which would involve major structural or operational changes, will be made only upon the approval of Congress as now provided by law."

b. Existing Guidance. Any action that reallocates storage requires a reallocation report. Guidance on reallocations, including funding of reallocation studies, can be found in ER 1105-2-100, Chapter 4, Section VII (Water Supply), Paragraph 4-32d, dated 31 October 1997. Additional information in the ER is contained in Chapter 6, Section XV (Cost Allocation), Paragraph 6-205, dated December 1990. Supplemental information on the suggested contents of a reallocation report can be found in Chapter 4 of IWR Report 96-PS-4, AWater Supply Handbook. All regular rules that apply to reallocations are also applicable to considerations under this EC. Examples of these are restrictions on the volume of storage reallocation (the lesser of 15 percent of total storage or 50,000 acre feet) and the suggestion to develop one reallocation report that would cover several future reallocations.

c. Reallocations from the Flood Control Pool. There are many opportunities to reallocate storage from existing purposes to municipal and industrial water supply. This reallocation authority is provided in the Water Supply Act of 1958, as amended (see above paragraph 5a) and the opportunities are described in IWR Report 96-PS-4, AWater Supply Handbook. The subject of this EC, however, is limited to reallocations of flood control storage, which in essence, expands the conservation pool into the flood control pool. In the absence of a reallocation, the flood control pool is normally not infringed upon and is kept empty to permit storage of runoff during times of high inflow. There are, however, three conditions that create opportunities for permanent reallocations from the flood control pool. These opportunities are as follows:

(1). Minor Reallocations. A minor reallocation is defined as that where the volume of lost flood control storage would have negligible impact on downstream flood control benefits. If the impact is significant, Congressional action is required. Care must be taken that the cumulative impact of continued minor encroachments into the flood pool does not result in a major impact. While one or two reallocations may have negligible impact, at some point in the future a system approach must be used.

(2). Reduced Floodplain Damages. An example is where the downstream floodplain use has reverted to more natural conditions, and/or supplemental protection has been provided since the project was designed and constructed.

(3). Over-Designed Flood Control Storage. Where reservoirs have been designed to a maximum site capacity larger than required by hydrologic analysis, excess flood control storage may be available.

d. Evaluation Considerations. Resource allocation decisions should be based on the NED evaluation criteria (see reference 4d). There are, however, a number of legal constraints and policy considerations when evaluating whether to pursue reallocations of storage at existing reservoir projects. Notable among such constraints and considerations are any impacts such reallocations might have on various project benefits and area resources, such as flood damage reduction, navigation, irrigation, hydropower generation, water quality, fish and wildlife conservation, recreation and environmental resources. A test of financial feasibility is performed to demonstrate to the potential water supply user that the use of a Corps reservoir as a water supply source is more cost-effective than the most likely alternative. This financial test is not the Corps decision criterion for changing the allocation of resources. All rules of reallocation apply (see paragraph 5b. Similarly, the Government evaluates impacts of such proposed reallocations on various project stakeholders. Such impacts might take a number of forms, including financial, social, or contractual effects that could occur, both directly and indirectly. The impacts will also vary in degree. Two of the stakeholders most commonly affected by water supply reallocations of reservoir storage are existing M&I water supply users and hydropower interests, although there are impacts on the beneficiaries of other project purposes as well.

6. Compensation to Existing Municipal and Industrial Water Supply Users.

a. Government's Authority. The Government's authority to grant non-Federal interests access to and use of storage in Federal reservoir projects derives from the Water Supply Act of 1958. Pursuant to that Act, the Government may include, through original construction or by modifications (such as through reallocation), sufficient water storage to meet the needs of non-Federal interests for municipal and industrial purposes, so long as such non-federal interests pay for the reasonable costs of provision of the storage (i.e., the storage's capital investment, operation, maintenance, repair, replacement and rehabilitation costs). P.L. 88-140, enacted in 1963, clarified the 1958 Act by guaranteeing the non-Federal interests a permanent right to acquired storage assigned to them, assuming their continued payment of reasonable costs. As such, these non-Federal water storage right holders can be considered to possess a veritable and perpetual ownership of a physical portion of the reservoir, akin to a real estate property interest. Further, the Government enters into written agreements with its water supply users that memorialize the rights recognized under the 1958 Act and guarantee, as a matter of contractual as well as of statutory law, that the storage rights of such users retain permanence. In light of (i) the statutory protection provided by the 1958 Act for users of municipal and industrial water supply storage at Corps reservoirs; (ii) the fact that the 1958 Act recognizes such protection as akin to a permanent property right to a physical part of the project itself (i.e., its storage); and, (iii) the Government's execution of binding agreements memorializing such storage rights, the Government takes particular care to preserve the ownership interests of its M&I water storage users.

b. Mitigation Storage. Whenever the conservation pool of a reservoir project is expanded into the flood control pool, the critical period dependable yield (which is produced from storage and inflow) per unit of storage will be reduced. This occurs because, even though there is more conservation storage available from which to draft water, the inflow into the reservoir remains the same. Since more users will be sharing the same inflow, the yield per unit of storage decreases even though the total yield of the project increases. While water storage contracts (agreements) do not guarantee a yield, due to fairness and possible legal liability, the Corps should not make additional (and discretionary) storage reallocations in a project which impose measurable negative impacts on existing water supply contracts by reducing their critical period yields. To avoid such negative impacts, sufficient storage would be reallocated to meet the needs of the new user and to maintain the dependable yield of the existing water supply contract holders. This additional storage required to keep existing users whole is termed Dependable Yield Mitigation Storage (DYMS). All costs associated with DYMS will be paid for by the new user of the new water supply storage space (i.e., the water supply requestor). Cost of storage is computed the same as any other reallocation (see paragraph 5b). Instructions on how to compute DYMS are provided in paragraph 6c. For a discussion of storage-yield relationships, see EM 1110-2-1420. Districts should determine when storage-yield curves need to be updated as part of their normal operations.

c. Computation of DYMS. Computation of DYMS requires an understanding of the use of project yield curves. During the formulation of projects that provide conservation storage, curves are typically developed that depict critical period dependable yield. The resultant curve is a conditional relationship which is based on a given bottom elevation for the conservation pool storage zone. Any point on the curve then, defines the relationship for storage and yield for a specific project. To apply this relationship to any project, either the total conservation pool storage or desired yield is selected and the other corresponding value is read from the yield curve. No further use is made of the yield curve unless a different total conservation pool is to be evaluated. The total yield of the given conservation pool storage then, is prorated among the various users based on the percentage of the total conservation pool storage that they have contracted for or that is allocated to them. In many cases it will be required that project critical period dependable yield curves be developed. This will be the case if a curve does not exist or there is any doubt as to the assumptions or source of an existing yield curve. The important consideration in DYMS computations is that all yield estimates for all water supply storage agreements and storage allocations for other purposes are on the same basis. The storage adjustments that are made, in many cases, will be quite small. Great care then must be taken to prevent presentation of data that would confuse the users and would be difficult to explain. There are many computer programs available that can be used to determine the critical period dependable yield by simulation of the operation of a reservoir operated either independently or in a multiple reservoir system. Again, however, it is important that the same program and input data be used throughout the analysis.

d. DYMS Examples. An understanding of DYMS can best be provided by examples. The first example (Appendix A) is a hypothetical situation. The procedure in the example is straightforward whenever the entire conservation pool of the existing project is allocated to water supply storage. However, when the existing project has some or all of the existing project allocated to hydropower, the procedure requires a trial and error reading of the yield curve with various assumptions of total conservation storage. This is required for two reasons: (1) it is Corps policy that, to the extent possible, impacts to hydropower will be compensated through means other than the application of DYMS (financial credits and operational modifications); and, (2) to comply with the requirement that critical period dependable yield be prorated to all users on the basis of the percentage of the total conservation pool that is allocated to each. The computations of DYMS should not be performed manually because of their tedious nature and more importantly to avoid round off errors in the storage adjustments. Appendix B provides an example computation for an actual case for the Greers Ferry Project in the Little Rock District. In the first example, hydropower storage is held constant because of the policy that DYMS does not apply to hydropower storage. The second example in the appendix assumes that hydropower yield is held constant. While it is not Corps policy to maintain hydropower yield constant, these computations are necessary in order to determine the maximum limit of operational changes to minimize the impacts on hydropower and to determine the adjustments to the financial credits provided to the power marketing agencies.

e. Adjustments to Water Supply Agreements. Districts should decide when to adjust water supply agreements. To avoid the excessive amount of work required to change every agreement each time a new reallocation is made, a suggested alternative is that changes be made at the same time the interest on the unpaid balance is adjusted. In the sample water supply agreement Article 5 - Payments (see reference 4d) this adjustment is made at 5-year intervals for reallocated storage agreements pursuant to Section 932 of the 1986 WRDA.

7. Compensation to Hydropower Users.

a. Government's Authority.

(1). Hydropower projects. The Government's authority to include and utilize storage in its reservoirs for the generation of hydropower derives from a host of water development acts (e.g., River and Harbor Acts, Flood Control Acts, Water Resource Development Acts, etc.) which authorize the construction, operation and maintenance of various reservoir projects for multiple purposes, including hydropower. Each specific project authority to include hydropower as a purpose imposes a specific duty on the Government to build and operate the project for the benefit of that hydropower interest (as well as for the benefit of all other purposes for which the project was authorized, such as flood control, recreation, water supply and navigation). The nature of the Corps' duty to protect each project's authorized purposes varies depending upon each specific project's statutory authorization (including details contained in any planning documents referenced by the statute, such as a report of the Chief of Engineers). Also, such project authorizations, generally grant the Corps some degree of discretion in construction and in managing each project, including allocations of storage, for the benefit of multiple competing purposes.

(2). Transfer of hydroelectric power. The Government's authority to release control over hydropower power generation at its projects to other agents derives from Section 5 of the Flood Control Act of 1944. The 1944 Act authorizes the Corps to turn over to the Department of Energy (DOE) power generated at Federal reservoirs which is surplus to project needs. Such power turned over by the Corps is assigned by DOE to its various power marketing administrations, such as the Bonneville Power Administration, the Western Power Administration, the Southwestern Power Administration, and the Southeastern Power Administration. The marketing agencies then market the power to various local power customers (e.g., municipalities, rural electric cooperatives and regional utility companies, etc.) pursuant to independently negotiated marketing agreements. The Corps' policy is to regularly consult with the power marketing administrations in an effort to manage its projects in accordance with the public interest, and make every effort to plan for and meet the projected hydropower benefits and revenues anticipated by the marketing agencies and their customers, although neither the Army nor the Corps play any role in the actual marketing of power to customers or in the negotiation of the marketing agreements. While the Corps does not execute agreements or make assurances regarding the reservation of a particular amount of storage in, or an amount of power to be provided by its reservoir projects in any given year, in some cases the Corps' informal partnership with the Federal power marketing agencies, and commitment to the appropriate management of hydropower projects, are memorialized in cooperative agreements. Notwithstanding the fact that the Corps does not have a legal obligation to compensate hydropower users for potential losses in energy and capacity as a result of reallocation actions, the Corps recognizes the importance of hydropower to the Nation and is willing to consider opportunities for minimizing those potential losses, as described in the following paragraphs.

b. Adverse Impacts. The adverse impacts to hydropower are similar to those experienced by water supply users. Negative impacts on hydropower as a result of a reallocation action are normally losses to both capacity and energy (see references at paragraph 4b and 4c for definitions and information on how to compute these losses). Power values for the impact analysis should be obtained from the Corps Hydropower System Analysis Mandatory Center of Expertise (see reference 4e). When the reallocation adversely impacts Federally authorized hydropower, it is Corps policy to mitigate the adverse impacts by financial credits and, where appropriate, through operational changes, as discussed in the paragraphs below. It is Corps policy not to provide DYMS for hydropower as is done for existing water supply users.

c. Financial Credits. When hydropower is adversely impacted by reallocation of the flood pool to satisfy additional water supply needs, one method to satisfy those losses is through the provision of financial credit. In these cases, credits will be provided to the hydropower account from a portion of the water supply storage proceeds. This credit is based on revenues foregone to the United States Treasury for repayment of the hydropower costs assigned to the project. Revenues foregone reflect the allocated costs to power upon which the rates are based. When reallocation is accomplished through this credit approach, in essence, the allocation of costs is adjusted without performing a laborious new cost allocation. Additionally, where existing Federal power delivery contracts require market purchases of power as a result of storage reallocations and withdrawals, the power marketing agency may obtain an additional credit for the funds expended for those purchases upon demonstration that they were made as a direct result of the reallocation.

d. Operational Changes.

(1). General. While financial credits have historically been used to compensate for hydropower losses, the PMAs have continued to express concern that such credits do not adequately compensate for losses, particularly for capacity losses. Capacity losses are more critical from a marketing standpoint since they are the principle basis for contractual agreements with their customers. Project operational modifications, where appropriate, could be an effective mechanism for compensating for hydropower losses. Modification of operating rules should be considered only where the new water supply storage is reallocated from the existing flood control pool. The implementation of operational changes will help marketing agencies fulfill their Federal contractual agreements and will not financially impact new water supply users. They will also result in a reduction of the financial credit to the marketing agencies. The following paragraphs describe policies and procedures for the consideration of operation changes in reallocation studies. Other operational changes may be considered by districts on an ongoing basis. Operational changes for compensating hydropower users suggested in this EC are over and above normal operational practices.

(2). Reservoir Regulation Schedule. The term reservoir regulation schedule refers to a compilation of operating criteria, guidelines, rule curves and specifications that govern basically the storage and release functions of a reservoir. In general, schedules indicate limiting rates of reservoir releases required during various seasons of the year to meet all functional objectives of the particular project, acting separately or in combination with other projects in a system. Schedules are usually expressed in the form of graphs and tabulations, supplemented by concise specifications and are prepared and implemented by Corps Water Control Management staffs.

(3). Water Control Plans. Water control plans include coordinated reservoir regulation schedules for project/system regulation and such additional provisions as may be required to collect, analyze and disseminate basic data, prepare detailed operating instructions, assure project safety and carry out regulation of projects in an appropriate manner. Regulations (ER 1110-2-240) require that necessary actions be taken to keep approved water control plans up-to-date. While water control plans and their documentation in water control manuals are developed for specific projects and reservoir systems, they will be revised as necessary to conform with changing requirements resulting from developments in the project area and downstream, improvements in technology, new legislation and other relevant factors. The instructions contained in ER 1110-2-240 are to be followed when modifications to water control plans become necessary due to reallocations of flood control storage to water supply. Funding of reallocation studies and associated modifications to water control plans/manuals is an internal decision to be made by each district, see ER 1105-2-100, paragraph 4-32d. The reallocation report shall describe the proposed modifications to the water control plan/manual as a result of the reallocation action, if applicable.

(4). Criteria for Evaluation and Selection. The following criteria will be used for evaluating and selecting an operational change.

(a). Limit Adverse Impacts. The operational change should not adversely affect flood damage reduction capability or any other project purposes.

(b). Limit Loss in Dependable Capacity. The objective of the operational change is to diminish as much as reasonably possible the loss in dependable capacity (and also energy if possible, but not probable), but not to increase dependable capacity beyond the level prior to the reallocation action.

(c). Maximize Seasonal Changes. Consider to the maximum extent possible, making only seasonal changes to the operation plan (i.e., to the time of year when flood control is less likely to be needed and hydropower capacity is most critical).

(d). Limit Elevation Change. The change in the elevation of the conservation pool should not exceed (or significantly exceed) what the elevation would otherwise be if DYMS was provided for hydropower. This, to some extent, should be satisfied by above criteria (b).

(5). Legal Considerations. There are three primary legal considerations that need to be addressed when project operational changes are recommended to compensate the hydropower purpose. The first relates to downstream impacts (i.e., is flood control jeopardized) and the second two considerations are related to the potential impacts of raising of the lake level. In this later action, raising of the lake could adversely impact the environment (e.g., impacts on trees and other vegetation, habitats, etc.) and it could impact on the real estate interest of surrounding land owners (e.g., marinas, residents, etc.). The impacts on these three items (flood control, environment and real estate) must be adequately addressed in the reallocation report (see paragraph 5b). Resolution of these issues will require extensive coordination with all stakeholders and users of the reservoir. If significant legal problems are encountered as related to these or other items, a decision must be made whether the action can proceed under the discretionary authority, or if Congressional action is needed.

8. Coordination Requirements. ER 1110-2-240, which implements Section 5 of P.L. 100-687, the Water Resources Development Act of 1988 (33 U.S.C. 2312), requires that before the Corps may modify a reservoir water control plan which will result in or require a reallocation of storage space or significantly affect any project purpose, it shall provide an opportunity for public review and comment to include public meetings. Paragraph 4-32d of ER 1105-2-100 also requires such coordination in all reallocation actions.

9. Documentation and Processing Requirements. As with all reallocations, seven (7) copies of the draft reallocation report developed under these procedures will be submitted to HQUSACE, Attn.: CECW-AR for action and one (1) copy will be submitted to HQUSACE, Attn.: CECW-P for information. This requirement for eight copies to be forwarded to HQUSACE is a change from that required by ER 1105-2-100. The ER will be changed to reflect this difference at the next revision. For finals which require approval at the Washington level, four (4) signed originals must be submitted to HQUSACE, Attn.: CECW-AR for action.

10. Implementation. This guidance is effective immediately. The procedures herein are generally not applicable to previous reallocation actions. Districts and divisions should inform CECW-PD of any problems with the implementation of this guidance.

FOR THE COMMANDER

ERIC R. POTTS
Colonel, Corps of Engineers
Executive Director of Civil Works

2 Encl.
Appendix A - DYMS Example
Appendix B - Discussion of Greers Ferry Lake DYMS

Appendix A
DYMS Example

An understanding of Dependable Yield Mitigation Storage (DYMS) is probably best provided by an example (Table A-1). The following assumptions are made (an exaggerated example for computational ease).

Table A-1; DYMS Example

Item	Existing project	Expanded project
Total conservation storage	100,000 a-f	300,000 a-f
Critical period dependable yield	200 cfs	300 cfs
Unit yield	2 cfs per 1000 a-f	1 cfs per 1000 a-f
Contracted storage (user # 1)	100,000 a-f	200,000 a-f
Dependable yield (user # 1)	200 cfs	200 cfs
Contracted storage (user # 2)	none	100,000 a-f
Dependable yield (user # 2)	none	100 cfs
DYMS	none	100,000 a-f

In this example, user #1 had a prior contract for 100,000 a-f of storage, which was the entire conservation pool of the existing project. The estimated critical period dependable yield for that storage was 200 cfs. Subsequently, a second user requested storage in the project sufficient to provide an estimated critical period dependable yield of 100 cfs. The sum of the required critical period dependable yield for both users would then be 200 + 100 = 300 cfs. Reading of the yield curve at 300 cfs indicated a required total conservation storage of 300,000 a-f. In the expanded project, user #1 requires 200,000 a-f rather than the contracted 100,000 a-f to provide an estimated critical period dependable yield of 200 cfs. The difference (200,000 B 100,000 = 100,000 a-f) is the DYMS. User #2 requires 100,000 a-f of storage to provide an estimated critical period dependable yield of 100 cfs. The water supply contract for user #1 would be amended at no cost to him to provide that his share of the conservation pool is 200,000 a-f and 2/3 of the total. The contract with user #2 would provide that his share of the conservation pool is 100,000 a-f and 1/3 of the total. User #2, however, would be required to pay for 200,000 a-f. The 100,000 a-f provided to him by the contract and the 100,000 a-f of DYMS storage required to maintain the critical period dependable yield of user #1.

The following two procedures are included to provide a general understanding of how a manual determination of DYMS would be accomplished for a project without storage allocated to hydropower (Table A-2) and for one with storage allocated to hydropower (Table A-3). It is assumed that the project yield curve already exists.

Table A-2: Procedure for a Project Without Storage Allocated to Hydropower

Step	Procedure
1	Tabulate the conservation storage allocated to each existing user. The sum of these should be equal to the total existing conservation storage.
2	Read the yield curve corresponding to the total existing conservation storage to obtain the total yield.
3	Prorate the total yield among the existing users on the basis of the percentage of the total conservation storage that is allocated to each user.
4	Add the yield required by the new user to the total yield provided by the existing conservation storage to arrive at the total yield to be provided by the expanded project.
5	Read the yield curve corresponding to the total yield to be provided by the expanded project to obtain the total conservation storage of the expanded project..
6	Prorate the total conservation storage of the expanded project to each of the existing users and the new user on the basis of the percentage of their yield to the total yield of the expanded project. The storage so determined will be each user's allocation.
7	The DYMS (the new user is responsible for paying for the DYMS) is the increase in storage determined in Step 6 over that provided in Step 1 for each of the users in the existing project.

Table A-3; Procedure for a Project With Storage Allocated to Hydropower

Step	Procedure
1	Tabulate the conservation storage allocated to each existing user including hydropower. The sum of these should be equal to the total existing conservation storage.
2	Read the yield curve corresponding to the total existing conservation storage to obtain the total yield.
3	Prorate the total yield among the existing users and hydropower on the basis of the percentage of the total conservation storage that is allocated to each user.
4	Assume a value for the total conservation storage of the expanded project. This value will be greater than the total conservation storage of the existing project.
5	Read the yield curve for the assumed total conservation storage of the expanded project to obtain the corresponding total yield.
6	Determine the storage required in the assumed expanded project for each of the water supply users in the existing project by using the percentage their existing yield is to the total yield of the expanded project. The storage required by the new use would be similarly obtained using the desired yield of the new user. The storage so determined would be each water supply user's allocation in the assumed expanded project. The remaining storage (assumed total conservation storage minus the sum of the water supply storage for each user) would be for hydropower. If this value is not equal to the hydropower storage tabulated in Step 1, repeat Step 4 through Step 6.
7	The DYMS (the new user is responsible for paying for the DYMS) is the increase in storage determined in Step 6 over that provided in Step 1 for each of the water supply users in the existing project.

Appendix B
Discussion of the Greers Ferry Lake DYMS
(Example with Hydropower Storage Held Constant)

This discussion is relative to a proposed expansion of the conservation pool at Greers Ferry Lake, AR. Greers Ferry Lake is a multiple purpose project, which had the following storage allocations prior to the proposed expansion (see Table B-1).

Table B-1; Greers Ferry Lake Storage Allocations, Prior to Expansion

Item	Elevation (Feet NGVD)	Storage Capacity (Acre-Feet)
Top of flood pool	487	2,844,500
Top of power pool	461	1,910,500
Bottom of power pool	435	1,194,000
Flood pool zone	461-487	934,000
Conservation pool zone	435-461	716,500
Hydropower storage		714,367
Water supply storage		2,133
Heber Springs W.S. agreement		1,008
CWS water supply agreement		225
Clinton water supply agreement		900

Community Water System (CWS) had requested additional storage sufficient to yield 6.8 MGD. However, they wanted this in two phases. Initially they just required 3.3 MGD. The example problem only addresses the 3.3 MGD requirement and the determination was made that it should be provided by an expansion into the flood pool. A detailed daily sequential reservoir routing computer program was utilized to determine the points on the dependable yield curve. This program was selected because the hydrologic data was already available and because the program had been used for numerous flood control and hydropower studies in the past. The detail required for hydropower analyses generally dictates that a weekly or daily reservoir routing model be utilized. Again, the most important consideration is not which routing model is used but rather that the same model and data set be used for the entire study.

The results of the routings produced the following four points on the dependable yield curve are shown in Table B-2. These data encompasses a 50,000 acre-foot expansion (the Corps= discretionary reallocation limit) into the flood pool.

Table B-2; Routing Results

Dependable Yield (cfs)	Required Conservation Storage (acre-feet)
909.2	716,500
914.0	722,200
930.5	741,500
952.0	766,500

The information in Table B-3 shows the results assuming that hydropower storage is held constant (the equivalent of the policy that DYMS does not apply to hydropower storage). The DYMS was computed as the sum of the difference of required storage (expanded project B existing project) for prior water supply storage contracts. The DYMS for this example is barely significant. CWS would be responsible for all costs of the added storage. The 4,031 acre-foot required to provide their phase 1 request and the 4 acre-feet DYMS required. After rounding to the nearest 1 acre-foot, the DYMS is distributed as 2 acre-feet for Heber Springs and 2 acre-feet for Clinton to maintain the yield of prior water supply contracts.

Table B-3; DYMS Holding Hydropower Storage Constant

Item	Existing Project		Expanded Project		DYMS
	acre-feet	cfs	acre-feet	cfs	acre-feet
Total conservation storage	716,500		720,535		
Critical period dependable yield		909.0		912.6	
Allocated storage (hydropower)	714,367		714,367		0
Dependable yield (hydropower)		906.5		904.8	
Contracted storage (Heber Springs)	1,008		1,010		2
Dependable yield (Heber Springs)		1.3		1.3	
Contracted storage (CWS - prior)	225		225		0
Dependable yield (CWS - prior)		0.3		0.3	
Contract storage (Clinton)	900		902		2
Dependable yield (Clinton)		1.1		1.1	
Contracted storage (CWS - phase 1)	None		4,031		
Dependable yield (CWS - phase 1)		none		5.1	
DYMS					4

Appendix B
Discussion of the Greers Ferry Lake DYMS
(Example with Hydropower Yield Held Constant)

The following example is included for the situation where an alternative is proposed in the reallocation report to preserve the hydropower yield (such an alternative might increase the average head and actually provide greater hydropower benefits than the existing project). The information in following Table B-4 shows the results of the analysis assuming that hydropower yield is held constant. The DYMS was computed as the sum of the difference of required storage (expanded project B existing project) for prior water supply storage contracts and hydropower.

Table B-4; Holding Hydropower Yield Constant

Item	Existing Project		Expanded Project		DYMS
	acre-feet	cfs	acre-feet	cfs	acre-feet
Total conservation storage	716,500		722,562		
Critical period dependable yield		909.0		914.3	
Allocated storage (Hydropower)	714,367		716,388		2,021
Dependable yield (Hydropower)		906.5		906.5	
Contracted storage (Heber Springs)	1,008		1,011		3
Dependable yield (Heber Springs)		1.3		1.3	
Contracted storage (CWS - prior)	225		226		1
Dependable yield (CWS - prior)		0.3		0.3	
Contracted storage (Clinton)	900		903		3
Dependable yield (Clinton)		1.1		1.1	
Contracted storage (CWS - phase 1)	none		4,035		
Dependable yield (CWS - phase 1)		none		5.1	
DYMS					2,028